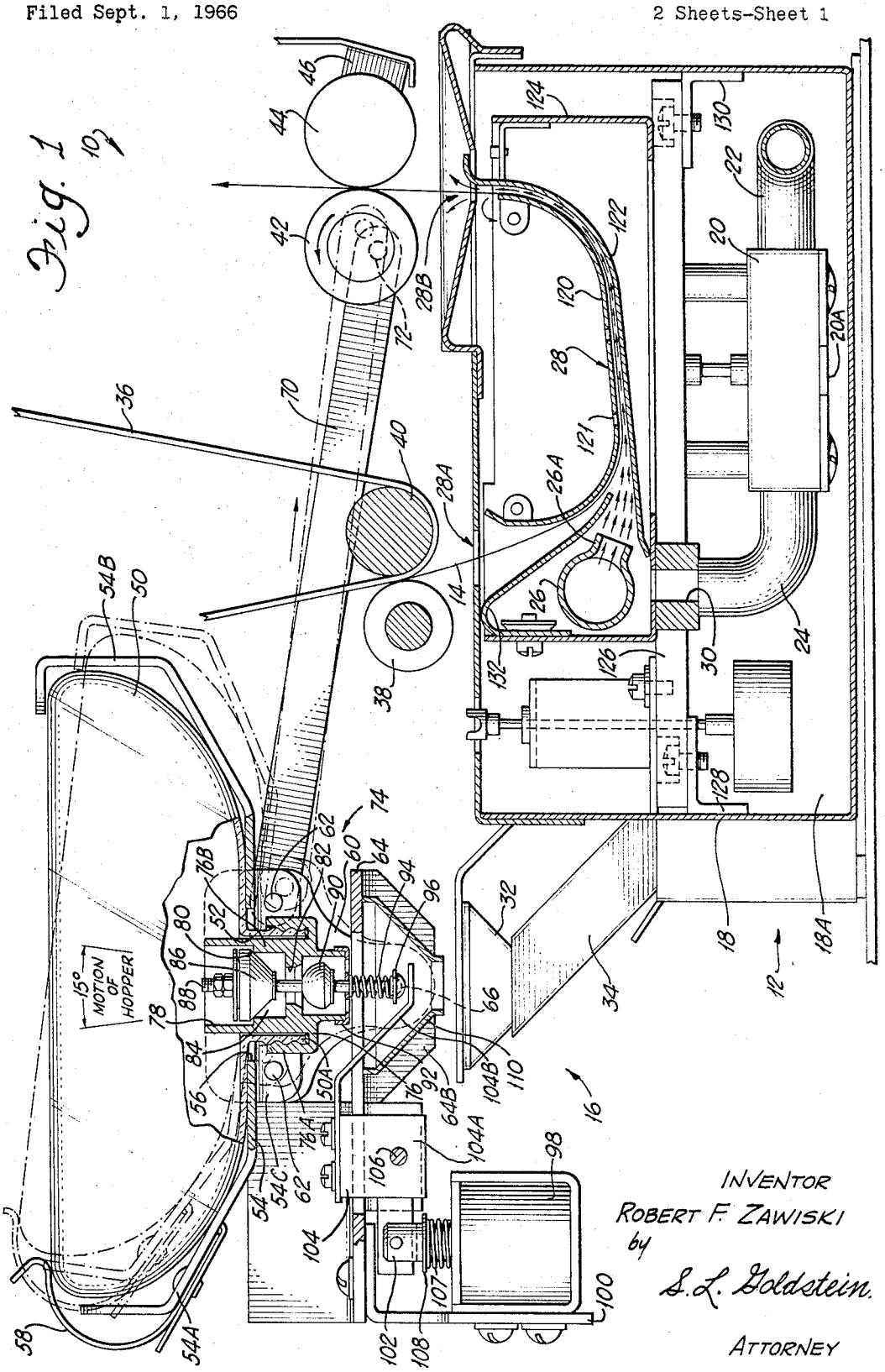
April 16, 1968 R. F. ZAWISKI 3,377,988

LIQUID DEVELOPER FOR PHOTOELECTROSTATIC COPIER

Filed Sept. 1, 1966 2 Sheets-Sheet 1

Fig. 1



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LIQUID DEVELOPER FOR PHOTOELECTROSTATIC COPIER

Filed Sept. 1, 1966 2 Sheets-Sheet 2

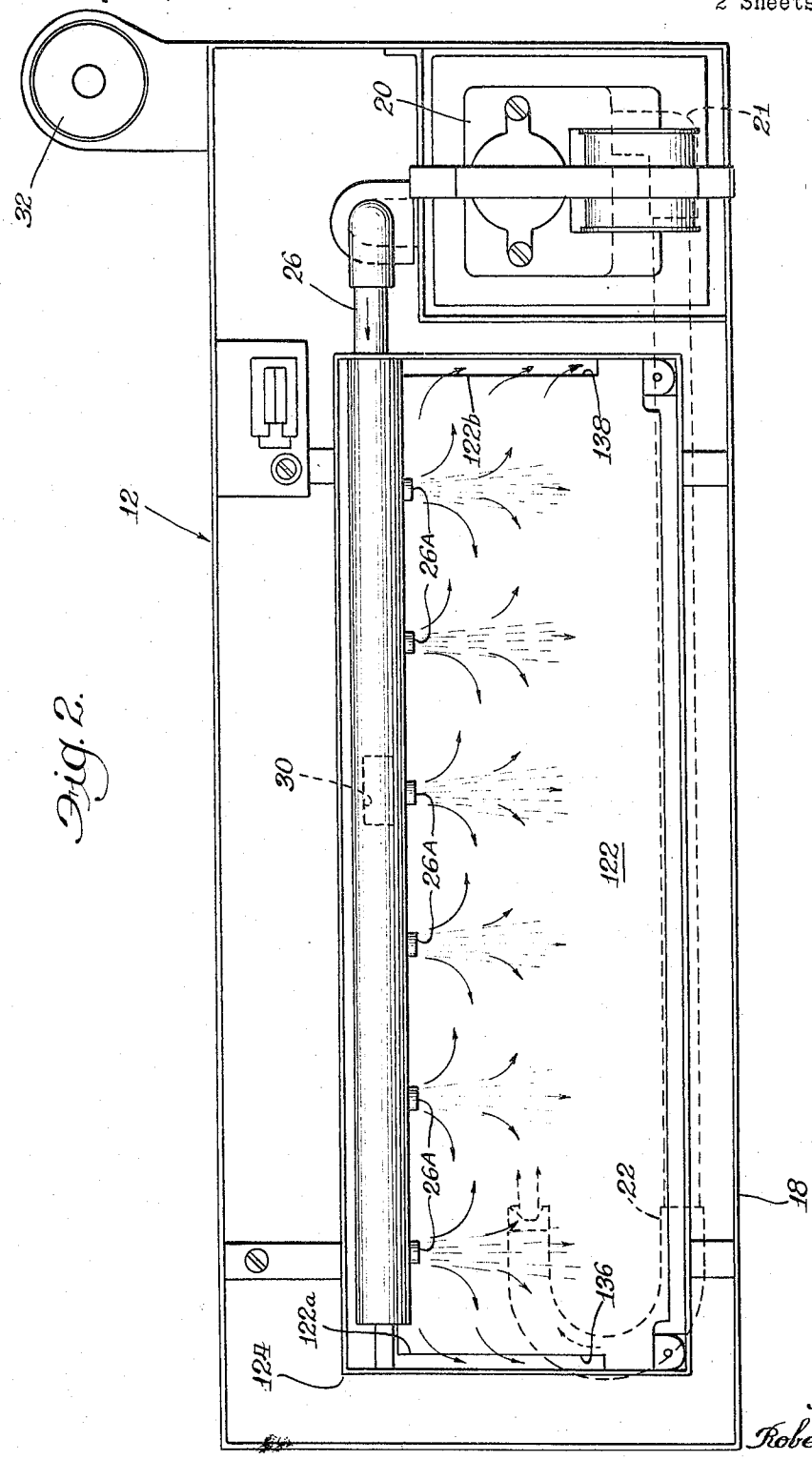


Fig. 2.

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3,377,988

LIQUID DEVELOPER FOR PHOTOELECTROSTATIC COPIER

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Filed Sept. 1, 1966, Ser. No. 576,613
17 Claims. (Cl. 118—637)

This invention relates to a liquid developer unit for photoelectrostatic copiers and, more particularly, to an assembly capable of depositing particles from a liquid carrier upon the surface of a moving sheet in accordance with a latent electrostatic pattern previously formed thereon and including devices for replenishing developer liquid used in the assembly.

Photoelectrostatic copiers using liquid developer units are frequently of the type in which the developer liquid is pumped from a reservoir to an applicator structure, such as a tank having sheet or web guiding means, in which the developer liquid is placed in contact with a surface of web or sheet material bearing a latent electrostatic image to be developed. The liquid generally comprises a liquid carrier containing electroscopic developer or toner powder that is deposited on the sheet or web material in accordance with the charge image. Deposition of the electrostatically attractable particles dispersed in the developer liquid is known to be enhanced by means of a conductive field control member placed very close to, but accurately spaced from, the surface of the sheet to be developed. The present invention embodies means for maintaining the proper spacing relationship between such a field control member and the sheet surface under the relatively unstable conditions wherein both the sheet and the developer liquid move through a confined space in the developer unit. In the presently preferred form of this invention there is provided a guideway for a sheet to be developed having an entryway and an exit through which the sheet is fed and from which it is withdrawn, respectively, by feed rollers. The guideway is arranged to expose the sheet to a dynamic body of liquid developer which is directed into the guideway adjacent the entryway along a plane that parallels the movement of the sheet through the guideway.

The guideway is made up of a pair of guide members in spaced apart relation, one member serving as a support for the sheet as it courses through the guideway and the other member is a conductive member placed in fixed closely spaced relationship to the upper guide member so as to provide a field control effect at the place where electrostatic deposition of particles is occurring. The sheet is held against the guide member by hydrodynamic forces generated in the liquid itself so as to provide consistent accurate spacing between the surface of the sheet and the field control member. Preferably, these hydrodynamic forces are generated by pumping or flowing the developing liquid rapidly from a series of orifices aimed at the entryway to the guideway so as to support the sheet against the upper guide member against the force of gravity and at the same time assist its movement through the guideway.

These liquid developer units frequently include agitating means to assure uniform developer composition or uniform distribution of the powder in the carrier. Because of the removal of the developer powder by the sheet or web material, it is necessary to replace or replenish the developer powder from time to time depending on the extent of use of the copier and other factors. The amount of powder in the developer liquid can be maintained at the desired level by periodically adding a developer concentrate including a rich mixture of powder and liquid carrier, or by changing the supply of developer liquid.

This is not satisfactory because of the expense of replacing the developer liquid, the time required, and the danger that a lower powder or toner level frequently cannot be observed before copy quality starts to deteriorate. Arrangements have been made to provide means for automatically adding developer liquid or concentrate at periodic intervals or on demand, but these arrangements frequently are not capable of adding carefully controlled quantities or are such that the added liquid is not of uniform consistency.

It is a general object of the present invention to provide a new and improved liquid developer unit for photoelectrostatic copiers.

Another object is to provide a liquid developer unit including new and improved means for bringing together the latent image bearing surface and the developer liquid under conditions for enhancing the deposition of the electroscopic powder to the latent image.

A further object is to provide a liquid developer unit including new and improved means for applying liquid developer to an electrostatic latent image bearing copy sheet in an environment of a conductive field controlled member.

A further object is to provide a liquid developer unit including new and improved means for replenishing the supply of developer liquid.

A further object is to provide a liquid developer unit including new and improved means for assuring the uniform consistency of developer liquid or concentrate added to the body of developer liquid contained in a reservoir for the unit.

A further object is to provide a liquid developer unit including means for accurately and automatically metering developer liquid from an oscillating or moving supply to a reservoir.

In accordance with these and many other objects, an embodiment of the invention comprises a liquid developer unit including a reservoir of developer liquid having removably superimposed thereon a fluid guideway assembly formed of a pair of spaced apart guide members for guiding the movement of an image bearing sheet or web material through the developer unit. One of the guide members is electrically conductive in order to provide a field control member at the sites where the developer liquid contacts the electrostatic latent image. The reservoir and guideway assembly are in communication by pump means which delivers fluid from the reservoir to the guideway assembly through a conduit system applying liquid developer to the image bearing surface of the sheet or web material which is fed into and out of the guideway assembly by sheet or web feeding means. The liquid developer feed system is arranged to discharge the developer as a dynamic body moving in a plane coextensive with the movement of the web or sheet through the guideway so as to maintain the imaged surface of the sheet in close proximity to but out of contact with the field control member.

To provide means for automatically replenishing the supply of developer liquid in the reservoir of the developer unit, a supply bottle of developer liquid or concentrate is mounted at a level above the reservoir on a supporting structure that is pivotally mounted on the main frame. This supporting structure is coupled to and driven by the web or sheet feeding means and continuously oscillates the supply bottle during periods of use of the machine so that the developer liquid in the supply bottle is always of uniform consistency in the periods of which metered quantities might be discharged to the reservoir.

To provide means for automatically metering predetermined quantities of developer liquid from the supply bottle to the reservoir, the outlet of the bottle is provided with a metering arrangement consisting of a metering

chamber defined by two spaced apart ports. The metering arrangement includes a pair of spaced valve elements, one of which normally closes one of the ports and the other of which normally opens the other of the ports. The two valve elements are connected to an actuating or operating element which bears against a lever actuated by a solenoid. The connection between the operating element and the lever is such as to permit relative movement therebetween, thereby accommodating or permitting the operating linkage including the solenoid and lever to remain in a stationary position on the housing while the supply bottle and metering assembly are pivoted in the manner described above. When a quantity of developer liquid is to be automatically dispensed to the reservoir of the developer unit, the solenoid is momentarily operated, and the lever shifts the two valve members to change the open and closed conditions of the ports defining the opposite ends of the metering chamber. When the solenoid is released, the metered quantity of developer liquid contained in the metering chamber is discharged to the reservoir. Since the supply bottle is always in movement to agitate its contents during operation of the machine, and since automatic dispensing of make-up developer liquid or concentrate to the reservoir occurs only during operation of the machine, the developer supplied to the reservoir is of uniform consistency.

Many other objects and advantages of the present invention will become apparent from considering the following detailed description in conjunction with the drawings in which:

FIGURE 1 is an elevational view in partial section of a developer unit embodying the present invention;

FIGURE 2 is a plan view of the developer unit of FIG. 1 with parts removed to show the fluid flow pattern through the guideway.

Referring now more specifically to FIG. 1, therein is illustrated a liquid developer assembly which is indicated generally as **10** and which embodies the present invention. The assembly **10** includes a liquid developer unit **12** into which sheet or web material **14** is fed to permit a latent electrostatic image carried on one surface thereof to be contacted by the developer liquid. The electroscopic powder in the developer liquid is selectively deposited on the latent image bearing surface of the material **14** to provide a visible image, and the developed sheet **14** is discharged from the unit **12** and dried or otherwise processed to place the visible image in permanent form. An assembly **16** is provided for automatically replenishing developer liquid or toner material consumed during the developing process by automatically metering a quantity of developer liquid or concentrate of uniform consistency from an agitated supply thereof to the unit **12**.

In general, the developer unit includes a housing **18**, a lower portion **18A** of which provides a reservoir containing a quantity of developer liquid in which is disposed a pumping means **20**. The pumping means **20** includes an inlet **20A** disposed below the upper surface of the developer fluid in the reservoir **18A** and an outlet **21** (FIG. 2). The outlet **21** is connected to an agitator tube **22** which is also disposed within the body of developer fluid in the reservoir **18A** and serves to provide a continuous current of developer fluid within the reservoir **18A** to agitate this mixture and insure its uniform consistency. The outlet of the pump **20** is also connected by a line **24** to a manifold or distributor **26** having a plurality of outlet orifices or nozzles **26A** which direct a stream of developer liquid through a narrow sheet or web guideway, indicated generally as **28**, to provide a dynamic body of developer fluid for both positioning the sheet or web **14** within the guideway **28** and to provide intimate contact between the developer fluid and the downwardly facing image bearing surface of the material **14**. The developer fluid discharged from the passageway **28** either falls directly into the reservoir **18A** or is returned thereto through a drain passage **30**, the effective cross-sectional area of which can be varied to control the quantity of developer fluid in the guideway **28**.

To provide means for supplying fluid concentrate from the metering assembly **16** to the reservoir **18A**, there is provided a funnel **32** which is disposed beneath the assembly **16** and secured to one side of the housing **18**. The funnel **32** discharges into the open upper end of a fluid conveying pipe or duct **34**, the lower end of which is in communication with the reservoir **18A**.

The liquid developer unit **12** is adapted for use in photoelectrostatic copying units of many different constructions. In the drawings, the developer unit **12** is shown in conjunction with a portion of a copying machine of the type shown and described in detail in the copending application of John V. Bruning et al., Ser. No. 457,649, filed May 21, 1965, which application is assigned to the same assignee as the present invention. As illustrated therein, the copying machine includes a flexible conveying means **36** which feeds the sheet or web material **14** downwardly from an exposing position in which the electrostatic image is developed to the nip between a pair of rollers **38** and **40** located above an inlet **28A** to the unit **12**. The rollers **38** and **40** feed the material through the passageway **28** to an outlet **28B** at which the leading edge of the material **14** is received between a pair of rollers **42** and **44**, either or both of which can be driven. The roller **44**, which engages the imaged surface of the material **14**, preferably is formed of a relatively hard material which may be electrically conductive, and a pad **46** engages the roller **44** along its outer periphery to remove any toner material or electroscopic powder. The outer periphery of the roller **42** preferably is formed of a somewhat resilient material and cooperates with the roller **44** to remove surplus developer liquid from the web material **14**.

The leading edge of the sheet or web material **14** fed into the inlet **28A** moves downwardly through the guideway **28** with the image surface facing downwardly. When the leading edge is advanced into proximity to the moving body of developer fluid provided by the distributor **26**, the sheet is forced upwardly so that the back of the material **14** is forced against the upper wall of the guideway **28** and the body of the developer liquid moves between the lower imaged surface and the lower wall of the guideway **28** to both develop the electrostatic image and to maintain the developed image from contact with the guideway **28**. The lower wall or guide member is preferably formed of a conductive material to improve image definition and density by controlling the field in the image area.

The assembly **16** for automatically metering developer liquid to the unit **12** includes a supply receptacle, bottle, or hopper **50** containing a quantity of developer concentrate. This concentrate comprises the liquid carrier and a quantity of developer material or toner greatly in excess of that found in the normal developer liquid. The bottle **50** includes a downwardly extending and externally threaded neck **50A** defining an outlet opening **52**. The bottle **50** is mounted on a carrier **54** having a centrally disposed opening **56** for receiving the neck **50A** of the bottle and a pair of upwardly extending arms **54A** and **54B**. The arm **54A** in turn includes an inwardly turned flange portion which is adapted to overlie the top wall of the supply bottle **50** to maintain this bottle in position on the carrier **54**. A resilient or spring member **58** is secured to the arm **54A** and includes an inwardly turned portion adapted to bear against the upper wall of the supply receptacle **50** to resiliently bias and hold the bottle **50** in position on the carrier **54**.

To provide a supporting structure by which the supply receptacle or bottle **50** is pivotally mounted on the copying machine, the lower wall of the carrier **54** is provided with a pair of opposed flange portions **54C**, only one of which is shown. These flange portions are secured to the upper ends of a pair of pivotal mounting plates **60**, only one of which is illustrated, by a plurality of fastening

devices 62, such as machine screws. The lower end of each of the two plates 60 is pivotally connected by a pivot pin 66 to one of two spaced flanges 64B on supporting member 64 rigidly secured to the frame of the copying machine. In this manner, the carrier 54 and the bottle 50 are pivotally mounted on the support member 64.

To provide means for oscillating the supporting structure and the supply receptacle 50, a link 70 is pivotally connected to the plate 60 at one end by one of the fasteners 62. The other end of the link 70 is connected to the roller 42 by a pivot pin 72 in eccentric relation to the center of rotation of the roller 42. Thus, as the roller 42 is rotated about its axis in a counterclockwise direction, the link 70 is reciprocated to oscillate the bottle 50. In one construction manufactured in accordance with the present invention, the roller 42 and the link 70 impart fifteen degrees of pivotal movement to the bottle 50, considered relative to a vertical axis.

To provide an assembly capable of being used with different supply bottles 50, the automatic dispensing assembly 16 includes a metering assembly indicated generally as 74 which is threadedly mounted on the neck 50A of the supply bottle 50 so that this assembly provides both a closure for the bottle 50 and the metering function. The unit 74 includes a member 76 having an internally threaded cap portion 76A which is threadedly engaged on the externally threaded neck 50A of the bottle 50 and a centrally disposed sleeve portion or body 76B. The body 76B includes an axially extending opening 78 of varying diameters, the upper end of which is in communication with the interior of the bottle. Since the upper end of the opening 78 is disposed above the bottom wall of the receptacle 50, the sediment or powder which settles to the bottom of the carrier liquid, usually a solvent having electrical insulating properties, cannot be discharged from this bottle. A first shoulder in the opening 78 forms a first port 80, and a second shouldered portion in the opening 78 defines a second port 82 spaced below the port 80. The portion of the axial opening 78 between the ports 80 and 82 provides a metering chamber indicated as 84.

The port 80 is adapted to cooperate with a valve element 86 carried on an upper end of a shouldered shaft 88, and a second valve member 90 carried on an intermediate portion of a shaft 88 is adapted to open and close the port 82. The lower end of the shaft or operating element 88 passes through an apertured closure cap 92 carried on the lower end of the body 76B. A compression spring 94 interposed between the lower surface of the cap 92 and a washer 96 carried on the lower end of the element 88 resiliently biases the operator element or shaft 88 into position shown in FIG. 1 in which the valve element 86 closes the port 80 and the port 82 is opened by the valve element 90.

To provided means for selectively actuating the metering assembly 74, a solenoid 98 is mounted in a fixed position on the supporting structure 64 by a bracket 100. The solenoid 98 includes an armature 102 that is pivotally connected at its upper end to one end of a lever means 104. The lever means 104 includes a mounting block 104A that is pivotally mounted on the support member 64 between a pair of depending flanges thereon by a shaft or pivot pin 106. The lever means 104 also includes an arm 104B secured at one end to the mounting block 104A and having a free end disposed beneath and bearing against or spaced slightly below the lower end of the actuating element or stem 88 for the metering assembly 74. A compression spring 107 interposed between an upper wall on the solenoid 98 and a washer or collar 108 secured to the armature 102 normally biases the armature 102 to the position shown in the drawing which is set by suitable stop means (not shown). The free sliding connection or space between the free end of the arm 104B and the lower end of the operator or stem 88 permits the oscillating movement of the carrier 50 and the supporting structure therefor while permitting the compression spring 94 to firmly bias the valve element 86 into engagement with the structure forming the port 80 so that this port is closed to prevent the discharge of developer concentrate from the bottle 50.

Developer liquid or concentrate from the bottle 50 is automatically dispensed to the reservoir 18A whenever the developer liquid in the reservoir 18A has been depleted of the electroscopic powder to a predetermined level. The developer fluid from the assembly 16 can be dispensed from the reservoir 18A in dependence on the linear length of copy material 14 that have been developed or in dependence on the periods of use of the machine. However, a preferred means of controlling the concentration of toner powder in the carrier liquid in 18A involves the dispensing of the concentrate in dependence on the quantity of toner material in the developer liquid in the developer unit 12 such as the one shown and described in detail in a contemporaneously filed application of Willian Maloney, Ser. No. 576,612, which application is assigned to the same assignee as the present application.

Whenever an indication is produced that developer fluid or toner material needs to be added to the reservoir 18A, the solenoid 98 is energized to move the armature 102 downwardly against the bias of the spring 107. This pivots the lever means 104 in a counterclockwise direction about the shaft 106 so that the right-hand or free end of the arm 104B moves upwardly. This moves the valve stem 88 upwardly against the bias of the spring 94 so that the valve element 90 seats and closes the port 82 and the valve element 86 moves upwardly out of engagement with the seat forming the port 80 to open this port. The stroke of the armature 102 must be such that the port 82 remains closed during the oscillation of the hopper or bottle 50. This permits developer fluid to flow downwardly through the axial opening 78 into the metering chamber 84. When the solenoid 98 is released, the compression spring 107 moves the armature 102 upwardly and pivots the lever means 104 in a clockwise direction about the shaft or pivot pin 106. This lowers the free end of the arm 104B and the spring 94 moves the valve stem 88 downwardly so that the valve element 90 opens the port 82 and the valve element 86 closes the port 80.

During this movement, the developer fluid contained in the metering chamber 84 is discharged outwardly through the openings in the cap 92. This fluid passes through a funnel 110 secured to the support 64, the funnel 32, and the fluid conveying means 34 to be discharged into the reservoir 18A. Because of the sliding connection between the arm 104B and the lower end of the valve stem 88, this metering operation can be and is performed during the oscillation of the bottle 50 by the link 70 and without interference.

The developer unit 12 (FIG. 1) is comprised of a fluid guideway 28 formed of a pair of spaced apart guide members 120 and 122 removably mounted on a frame 124 which resides within the upper section of a larger fluid reservoir tank 18. The frame 124 is removably supported on a shelf 126 secured to the side walls of the tank 18 by means of brackets 128, 130. A guide plate 132 is positioned beneath the inlet 28A which serves to guide the web material 14 into the guideway 28 and also serves as a baffle plate directing the stream of developer liquid at the face side of the web material 14 entering the guideway. As described earlier, the stream of fluid being pumped out of the orifice 26A provides a dynamic body of fluid for supporting the back side of the web material 14 against the guide member 120 maintaining the face side out of contact with the guide member 122 and freely accessible to the dynamic body of developer fluid moving through the guideway 28.

It is deirable that the lower guide member 122 be of a conductive material providing a ground plane or field

control member to enhance the development of the electrostatic image with the developer. In this circumstance it is desirable to maintain the face side of the web material in close proximity to the ground plane while maintaining the guideway 28 wide enough to permit sufficient quantities of fluid to move past the face. The space between the guide members may vary from 1/64" to 1/4", preferably 1/32" to 1/16".

Referring to FIG. 2, the upper frame is shown with the upper guide member 120 and guide plate 132 removed to expose to view the guide member 122 during actual development. The developer fluid 18A is pumped by the pump 20 from the lower reservoir into the tube 26. The fluid is discharged from the nozzles 26A located at equally spaced locations along the tube 26 directing the stream of fluid into the guideway 28.

The opposite edges 122*a* and 122*b* of guide member 122 do not reach the walls of the support frame 124 providing a pair of longitudinally extending openings 136, 138 at the opposite sides of the member. The presence of the openings 136, 138 along the sides of the member 122 produces multidirectional movement of the fluid. The dynamic body of fluid moves parallel to the direction of the web and also cross current toward the openings 136 and 138. As the fluid leaves the guideway 28 through the openings 136 and 138, it falls directly into the reservoir 18A.

The multidirectional fluid flow pattern is advantageous in keeping the concentration of powder uniform throughout the fluid body in the guideway 28 due to this agitation and thereby prevents the settlement of powder on the member 122, since it is continually flushed free of any accumulation. Additionally, there is movement of fluid from the guideway into the drain 30 which is equipped with a slidable cover (not shown) for varying the size of the drain opening. Another advantage of this fluid movement is an aid to development since it continually "washes" the latent image bearing surface with fresh developer liquid. Discharging the fluid into the guideway 28 along the direction of movement of the web material 14 aids the forward movement of the web through the guideway 28.

The capacity of the pump in selected to deliver sufficient liquid to fill the channel and partially cover the upper guide member 120 which has openings 121 to permit the escape of some fluid from the guideway 28 and at the same time keep pace with the volume of fluid falling into the reservoir 18A through the openings 136 and 138.

Although the present invention has been described with reference to a single illustrative embodiment thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this invention.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. In a developer construction of the type in which a developer liquid from a reservoir contacts sheet or web material containing an electrostatic image,
- a supply receptacle for containing a quantity of developer liquid,
- a supporting structure carrying the receptacle and mounting the receptacle for movement,
- feeding means for moving the sheet or web material relative to the developer construction, and
- drive means coupled to the supporting structure and actuated by the feeding means for moving the supporting structure to agitate the contents of the supply receptacle carried thereon.

2. The construction as claimed in claim 1 in which said supporting structure includes
- a metering assembly connected to the receptacle and adapted to discharge a measured quantity of developer liquid to the reservoir, said metering assembly being carried on and movable with the supporting structure, and
- actuating means for operating the metering assembly, said actuating means being mounted in a fixed position and having a coupling to the metering assembly providing relative movement of the actuating means and the metering assembly during movement of the metering assembly with the supporting structure.

3. The construction as claimed in claim 2 in which said metering assembly includes
- a metering chamber defined by two spaced ports and a pair of valve elements alternately movable into engagement with the two ports,
- an operating means connected to the two valve elements said operating means normally positioning one of the valve elements to close one of the ports and positioning the other of the valve elements to open the other of the two ports, and
- an actuating assembly for selectively moving the operating means to an alternate position to open said one port and to close said other port to fill the metering chamber from the supply vessel through said one port and for moving the operating means back to the normal position so that the quantity of developer liquid in the metering chamber is discharged to the reservoir through said other port.

4. The developer assembly set forth in claim 3 in which
- the operating means includes an element mounted for reciprocating movement, and
- the actuating assembly includes a pivotally mounted lever bearing against one end of said element.

5. The developer assembly set forth in claim 3 including
- means mounting the supply vessel for movement, and
- drive means for moving the supply vessel to agitate the contents thereof so that the developer liquid is mixed.

6. The developer assembly set forth in claim 5 including
- means mounting the metering assembly and operating means for movement with the supply vessel, and
- means mounting the actuating assembly in a fixed position,
- said actuating assembly and operating means being coupled for movement relative to each other.

7. The developer assembly set forth in claim 5 including
- feeding means for moving the sheet or web material relative to the developer assembly, and
- means for actuating the drive means in synchronism with operation of the feeding means.

8. A liquid developer unit in which an electrostatic image on one surface of sheet material is developed by contact with a developer liquid containing electroscopic powder comprising
- a reservoir tank adapted to contain a body of developer liquid,
- a first generally curved structure supported above the level of the developer liquid in the tank,
- a second generally curved stationary structure disposed above and closely adjacent the first curved structure to define a generally curved passageway having a sheet material inlet and an outlet spaced from each other,
- feeding means for feeding sheet material through the passageway with the one surface facing the first curved structure,
- an elongated liquid inlet means to said passageway formed in said first structure and located between the sheet material inlet and the outlet, said liquid inlet means extending transverse to the direction of movement of the sheet material through the passageway and disposed at a level below said sheet outlet means,
- an elongated liquid distributor means disposed in communication with the liquid inlet means, and

a pumping means connected to the liquid distributor means for pumping developer liquid from the reservoir through the liquid distributor means and the liquid inlet means to flow through the passageway in the direction of movement of the sheet material and toward the outlet, the pumping means providing a sufficient body of developer liquid to contact and develop the electrostatic image on the one surface of the sheet material and to hold the one surface of the sheet material out of contact with the first curved structure.

9. The liquid developer unit set forth in claim **8** including a liquid distributor connected to the pump outlet and having a plurality of nozzle means spaced from each other along the width of the passageway.

10. The liquid developer unit set forth in claim **8** including a fluid agitating tube disposed within the body of developer liquid in the reservoir and connected to the outlet of the pumping means.

11. The liquid developer unit set forth in claim **8** in which the outlet through which the sheet material and at least part of the developer liquid passing through the passageway are discharged is disposed above the elongated liquid inlet means through which the developer liquid enters the passageway.

12. The liquid developer unit set forth in claim **8** in which the first and second structure includes at least one discharge opening from the passageway disposed along one edge thereof so that a portion of the developer liquid moves generally transverse to the direction of movement of the sheet material through the passageway to be discharged through the discharge opening.

13. The liquid developer unit set forth in claim **8** in which the first curved structure includes a first portion extending downwardly from a position disposed above the liquid distributor means and a second portion extending upwardly from below the liquid distributor means toward the outlet, said first and second portions being spaced at their lower ends to form the liquid inlet means.

14. The liquid developer unit set forth in claim **13** including a drain port adjacent the lower end of the second portion of the first curved structure for returning developer liquid to the reservoir tank.

15. The liquid developer unit set forth in claim **8** including a supply receptacle mounted in communication with the reservoir tank and adapted to contain a supply of liquid containing electroscopic powder, and dispensing means connected to the supply receptacle and operable to dispense a quantity of liquid containing powder to the body of developer liquid in the tank.

16. The liquid developer unit set forth in claim **15** including mounting means for movably mounting the supply receptacle, and drive means coupled to the supply receptacle for moving the supply receptacle to agitate the contents thereof.

17. The liquid developer unit set forth in claim **16** in which the drive means includes means coupled to and driven in synchronism with the feeding means.

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